



Background

Woman-Owned Privately Held U.S. Corporation
established in 2003



<https://www.RecoTechnologies.com>

<https://www.youtube.com/@recotechnologies>

Founders: [Dr. Homayoon Beigi \(President\)](#) and Ms. Pargol J. Saatchi (VP – Marketing)

Dr. Beigi – Lead Researcher:

BS'84, MS'85, and PhD'91 – Columbia University

Mechanical Engineering: Research – Pioneered Adaptive Learning Control Field, Pioneered Nonlinear Optimization for Multilayered Neural Networks, Machine Health Prognosis, Zero Gravity Fluid Research, Kinematic Analysis

Former IBM Research Scientist – 10 years

Lead Researcher: Online Handwriting Recognition, Speech Recognition, Speaker Recognition, and Online CMN Music

Columbia University Professor – 28 years

Computer Science Department: Fundamentals of Speech Recognition, Mathematics of Machine Learning and Signal Recognition, Many Independent Research Projects

Mechanical Engineering Department: Digital Control Systems, Applied Signal Recognition, Several PhD Committees on Control and Signal Processing

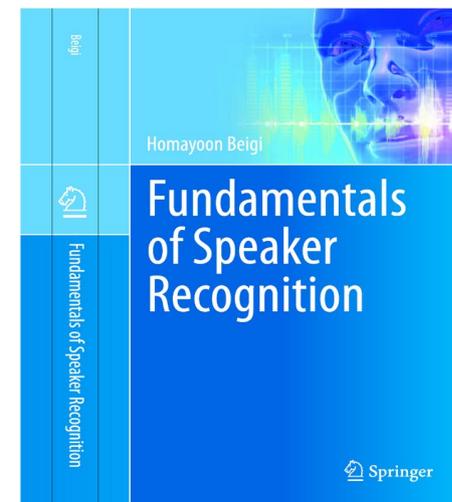
Civil Engineering Department: Advisor to 4 PhD students, 2 graduated and 2 on their way, in Structural Health Monitoring Research

Electrical Engineering Department: Handwriting, Speech, and Speaker Recognition

100+ publications and 13 granted patents

Active Liaison – VoiceXML, ASNSI M1, ISO Standards on Speaker Recognition

NIST and FBI Panelist



First and Only Textbook on Speaker Recognition

Homayoon Beigi – 2011
ISBN: 978-0-387-77591-3

1000+ Pages with
26 chapters
plus **177** illustrations



Research and Development Activities



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Mission: Algorithm and Architecture Research and Development – *Core Technologies*

Markets: Technology Licensing and Custom Development to Government Contractors and Private Industry, including Educational and Non-Profit Organizations

Product Engines:

RecoMadeEasy® Speaker Recognition



RecoMadeEasy® Speech Recognition

RecoMadeEasy® Face and Object Detection and Recognition

RecoMadeEasy® AudioVisual Recognition

RecoMadeEasy® Emotion Detection

RecoMadeEasy® Language Detection

RecoMadeEasy® Structural Health and Earthquake Monitoring

RecoMadeEasy® Access Control



Advance Programming Interface (API) (All Engines)



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Code: Over 5 Million Lines of c++ code Developed over 20+ years – optimized to run standalone

Operating Systems: Linux and Android (all running on the client's devices – no cloud or access/connection to our services necessary)

APIs: 1. Client/Server API – Websocket Interface

Server Software will handle all worker allocations, listens for streams and returns JSON results
Sample Client code is provided in C++, as well as the API documentation for websocket Interface through any chosen computer language such as python, javascript, etc.

2. Standalone applications with full capability for processing live or on-disk media, JSON results are returned

3. C++ shared libraries provided for linking by the client. Sample c++ code is provided with Full Capabilities, for running all the features of the engines by linking with the code.

4. Android Service running entirely as native c++ code on the Android device. The service gets automatically deployed when client code requests a connection. All Service and Client code run on the same Android Device with no need for any network connectivity.

**All Engines Run Entirely on Edge Devices
No External Network Connection Needed**



RecoMadeEasy® Speaker Recognition (Full Diarization)

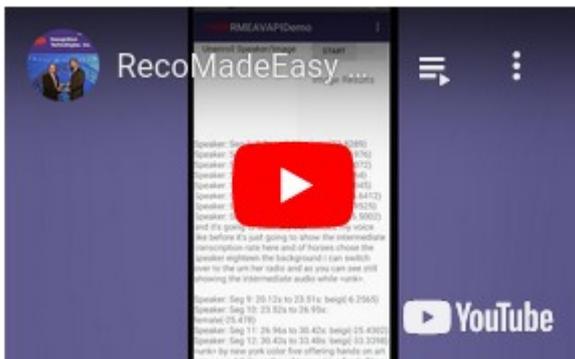


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- Modalities:**
1. Speaker Identification (Open- and Closed-Set)
 2. Speaker Verification (Authentication)
 3. Audio Classification (Event, Gender, Music, Speaker)
 4. Full Diarization (Combined with our Speech Recognition)

Demo:





RecoMadeEasy® Speech Recognition (Full Diarization)



<https://www.RecoTechnologies.com>

<https://www.youtube.com/@recotechnologies>

Features:

1. English, Spanish, Mandarin, Arabic, German, Japanese, Korean, Russian, Vietnamese, Tamil, Telugu, Gujarati.
2. 30 other languages are being developed
3. Word-Alignment information – Timestamps
4. Full Diarization in conjunction with our Speaker Recognition

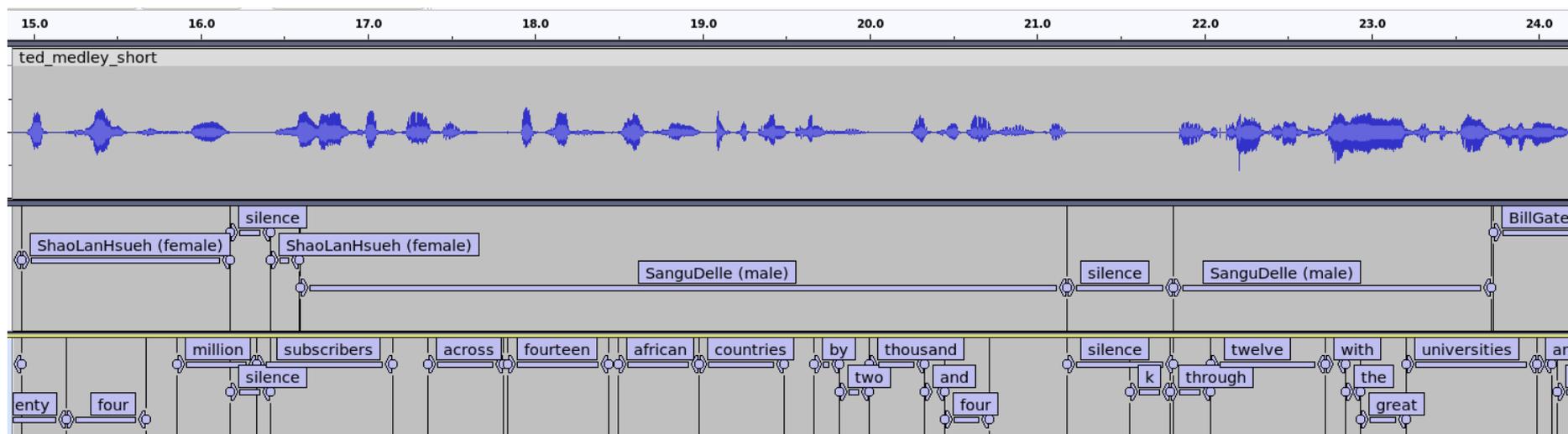
Demo:



Demo:



Demo of speed of transcription on CPU





RecoMadeEasy® Face and Object Detection and Recognition



<https://www.RecoTechnologies.com>

<https://www.youtube.com/@recotechnologies>

Features:

1. Fully Trainable on CPU with single images
2. Image need not be segmented for enrollment
3. Same codebase as our other engines and fully Integrated to use on video stream together with other engines

Demo:





Building and Bridge Health Monitoring

*Speaker Recognition Techniques enable Recognition of the **Vibration Signature of Structures***

- Define “Normal” Conditions through Learning
- Recognize Deviations from the “Norm”
- Capture “Big Data” from Varying Locations on Healthy Structures
- Validate Recognition of Damages through Simulation

Opportunity:

- **Health Prognosis** of Buildings and Bridges
- **Damage Detection** after Natural Disasters

Potential Impact:

- Quicker assessment of Damages after natural disasters
- Realtime Proactive Assessment of Damages
- Reports on Localization of Damages





Selected Patents and Publications

Textbooks:

Homayoon Beigi, [Fundamentals of Speaker Recognition](#), Springer, New York, 2011, ISBN: [978-0-387-77591-3](#) – Second Edition to be released by the end of 2023.

Homayoon Beigi, Mathematics of Machine Learning and Signal Recognition, Springer, New York, 2023 (expected).

Technical Reports:

Xing Yi Liu and Homayoon Beigi, [Efficient Ensemble with Time-Delay Neural Network for Punctuation Restoration](#)," Recognition Technologies Technical Report No. RTI-20230224-01, Feb. 24, 2023 , DOI: [10.13140/TG,2.2.29800.75528](#).

J. Nathaniel Holmes and Homayoon Beigi, [A Transaction Represented with Weighted Finite-State Transducers](#)," Recognition Technologies Technical Report No. RTI-20230131-01, Jan. 31, 2023 , DOI: [10.13140/RG,2.2.35825.15205](#).

Mustafa Eyceoz, Justin Lee, and Homayoon Beigi, [Modernizing Open-Set Speech Language Identification](#)," Recognition Technologies Technical Report No. RTI-20220520-01, May 20, 2022 , DOI: [10.13140/RG,2.2.24797.28647](#).

Siddharth S. Nijhawan and Homayoon Beigi, [Bi-LSTM Scoring Based Similarity Measurement with Agglomerative Hierarchical Clustering \(AHC\) for Speaker Diarization](#)," Recognition Technologies Technical Report No. RTI-20220519-02, May 19, 2022 , DOI: [10.13140/RG,2.2.13977.29288](#).

Benjamin Kepecs and Homayoon Beigi, [Automatic Spoken Language Identification using a Time-Delay Neural Network](#)," Recognition Technologies Technical Report No. RTI-20220519-01, May 19, 2022 , DOI: [10.13140/RG,2.2.21631.89763](#).

Amith Ananthram, Kailash Karthik Saravanakumar, Jessica Huynh, and Homayoon Beigi, [Multi-Modal Emotion Detection with Transfer Learning](#)," Recognition Technologies Technical Report No. RTI-20201113-01, Nov. 13, 2020.

Sitong Zhou and Homayoon Beigi, [A Transfer Learning Method for Speech Emotion Recognition from Automatic Speech Recognition](#)," Recognition Technologies Technical Report No. RTI-2020330-01, Mar. 30, 2020



Book Chapters:

 Homayoon Beigi, Speaker Recognition, In: [Jajodia S., Samarati P., Yung M. \(eds\) Encyclopedia of Cryptography, Security and Privacy. Springer, Berlin, Heidelberg, 2021](#) [10.1007/978-3-642-27739-9_747-2](#).

Kyle L. [Hom](#), Homayoon Beigi, and [Raimondo Betti](#) “Application of Speaker Recognition x-Vectors to Structural Health Monitoring”, In: [Mao, Zhu \(ed\), Model Validation and Uncertainty Quantification, Vol. 3, Ch. 13, pp. 139-148, isbn: 978-3-030-77348-9. Springer International Publishing, Berlin, Heidelberg, 2022,](#) [10.1007/978-3-030-77348-9_18](#).

[Eleonora M. Tronci](#), Homayoon Beigi, [Maria Q. Feng](#), and [Raimondo Betti](#) “Transfer Learning from Audio Domains: A Valuable Tool for Structural Health Monitoring ”, In: [Grimmelsman, Kirk \(ed\), Dynamics of Civil Structures, Vol. 2, Ch. 11, pp. 99-107, isbn: 978-3-030-77142-3. Springer International Publishing, Berlin, Heidelberg, 2022,](#) [10.1007/978-3-030-77143-0_11](#).

 Homayoon Beigi, “A Hybrid Approach to Automated Rating of Foreign Language Proficiency,” Mobile Speech and Advanced Natural Language Solutions, [Amy Neustein and Judith Markowitz \(Eds.\), Springer, New York, 2013,](#) [ISBN: 978-1-4614-6017-6](#).

 Homayoon Beigi, “Speaker Recognition: Advancements and Challenges,” New Trends and Developments in Biometrics, [Jucheng Yang and Shan Juan Xie \(Eds.\), 2012, ISBN: 980-953-307-576-6](#) .

Homayoon Beigi, “Speaker Recognition,” Encyclopedia of Cryptography and Security (2nd ed.), [Henk C.A. van Tilborg and Sushil Jajodia \(Eds.\), Springer, New York, 2011, pp. 1232-1242, ISBN: 978-1-4419-5906-5, DOI: 10.1007/978-1-4419-5906-5_747](#).

 Homayoon Beigi, “Speaker Recognition,” Biometrics / Book 1, [Jucheng Yang \(ed.\), Intech Open Access Publisher, 2011, pp. 3-28, ISBN: 978-953-307-618-8](#).



Patents:

Patent Number: [US 10,042,993 B2](#)

Homayoon Beigi, "[Access control through multifactor authentication with multimodal biometrics.](#)" Filed, June 23, 2015, Granted, August 7, 2018.

Patent Number: [US 9,495,646 B2](#)

Homayoon Beigi, ~~Raimondo Betti~~, and ~~Luciana Balsamo~~, "[Monitoring Health of Dynamic System.](#)" Filed, June 5, 2014, Provisionally filed, June 5, 2013, Granted, November 15, 2016.

Patent Number: [US 9,064,257 B2](#)

Homayoon S.M. Beigi, "[Mobile Device Transaction using Multi-Factor Authentication.](#)" Filed, Nov. 2, 2011, Granted, Jul. 23, 2015.

Patent Number: [US 7,474,770](#)

Homayoon S.M. Beigi, "[Method and Apparatus for Aggressive Compression, Storage and Verification of the Dynamics of Handwritten Signature Signals.](#)" Filed, June 28, 2005, Granted, January 6, 2009.



Standards, Journals, Conferences:

Eleonora M. Tronci, Homayoon Beigi, and Raimondo Betti, "A Damage Assessment Methodology for Structural Systems using Transfer Learning from the Audio Domain," *Mechanical Systems and Signal Processing (MSSP)*, Vol. 194, Elsevier, July 2023.

Eleonora M. Tronci, Homayoon Beigi, Maria Q. Feng, and Raimondo Betti, "A transfer learning SHM strategy for bridges enriched by the use of speaker recognition x-vectors," *Journal of Civil Structural Health Monitoring*, May 23, 2022, DOI: 10.1007/s13349-022-00591-3.

Eleonora M. Tronci and Homayoon Beigi and Maria Q., Feng and Raimondo Betti, "Transfer Learning from Audio Domains a Valuable Tool for Structural Health Monitoring," *Proceedings of the 39th IMAC, A Conference and Exposition on Structural Dynamics*, Feb. 8-11, 2021. **Recipient of the Best Paper Award in the Dynamics of Civil Structures Technical Division**

Kyle L. Holm and Homayoon Beigi and Raimondo Betti, "Application of Speaker Recognition $\{x\}$ -Vectors to Structural Health Monitoring," *Proceedings of the 39th IMAC, A Conference and Exposition on Structural Dynamics*, Feb. 8-11, 2021.

Amith Ananthram, Kailash Karthik Saravanakumar, Jessica Huynh, and Homayoon Beigi, "Multi-Modal Emotion Detection with Transfer Learning," *Natural Language, Dialog and Speech Symposium (NDS2020)*, Nov. 13, 2020, New York Academy of Science, New York City, USA.

Shiyali Goel and Homayoon Beigi, "Cross-Lingual Cross-Corpus Speech Emotion Recognition," *14th Annual Machine Learning Symposium*, March. 13, 2020, New York Academy of Science, New York City, USA.